In the longer run, consumer prices for broccoli could return toward current levels if new, low cost weed control methods are developed. However, current information suggests that this development is doubtful. It is very likely that increased weed pressures over time would cause yield reductions, which would likely result in retail price increases of undetermined magnitude.

Social/Community Impact

Although data limitations prevent an in-depth evaluation of the social and community impacts of prohibiting the use of nitrofen, a few potential impacts may be noted:

1. Additional hoeing operations and mechanical cultivations required by alternative weed control programs would increase the seasonal demand for field labor and possibly bid up current wages. In some areas there could be seasonal shortages of field labor.
2. The use of alternative weed control programs or the reallocation of land to other crops could lead to an increased demand for new farm equipment and other factors of production.
3. The potential long-term reductions in broccoli production could cause some local processors to operate at a less than optimum level of output. In some cases, processors might need to search out new, and more distant supply outlets for broccoli or reinvest in new machinery capable of processing alternative crops.

Limitations of Analysis

1. There are insufficient biological and economic data for long run estimates of potential crop shifts following a possible regulatory action on nitrofen.
2. This analysis assumed the availability of labor for additional hoeing operations and mechnical cultivations required by alternative weed control programs used on broccoli.
3. The price of field labor is assumed to remain constant in the short run, at $7.50 per hour.

Table 1. Per Acre Cost of Preemergent Nitrofen Weed Control Programs Used on Broccoli in California

Weed Control Program a/	Application Rate (lbs. a.i.)	Cost per lb. a.i. ($) b/	Herbicide Treatment Cost per Acre ($) c/	Cultivation Costs per Acre ($) e/	Hoeing Costs f/	Total Weed Control Cost per Acre ($)
nitrofen pre.	2	7.42	22.84	21.00	52.50	96.34
nitrofen + CDEC pre.	2 + 2	7.42 + 6.63	36.10	21.00	52.50	109.60
nitrofen + DCPA pre.	2 + 4.5	7.42 + 6.72	53.08	21.00	52.50	126.58
trifluralin pre-inc.	0.5	12.60	23.30 d/			
+				21.00	52.50	
nitrofen pre.	2	7.42	22.84			
			46.14			119.64
nitrofen pre.	2	7.42	22.84			
+						
DCPA post.	4.5	6.72	38.24			
			61.08	21.00	52.50	134.58
nitrofen pre.	2	7.42	22.84	21.00	--	43.84

a/ Control programs and application rates were developed by the Nitrofen Assessment Team. Assumes band herbicide treatments. Pre = preplant application; Pre-inc. = preplant soil incorporation; post. = postplant application.
b/ Based on 1981 pesticide prices reported in Galt et al., 1981, p. vii. Nitrofen cost based on 1980 price.
c/ Includes herbicide application cost at $8.00 per acre for all treatments except as noted.
d/ Includes pre-plant soil incorporation cost of $17.00 per acre.
e/ Three cultivations at $7.00/acre/cultivation.
f/ Assessment Team specified hoeing requirements as indicated.

Table 2. Total Cost of Nitrofen Weed Control Programs Used on Broccoli in California

Weed Control Program a/	Cost per Acre ($) b/	Number of Acres Treated c/	Total Cost ($)
nitrofen preemergence	96.34	36,285	3,496,000
nitrofen + CDEC preemergence tank-mix	109.60	3,557	390,000
nitrofen + DCPA preemergence tank-mix	126.58	1,423	180,000
trifluralin preplant incorporated plus nitrofen preemergence	119.64	712	85,000
nitrofen preemergence + DCPA postemergence	134.58	712	96,000
nitrofen preemergence (no hoeing)	43.84	28,459	1,248,000
		71,148	5,495,000

a/ Programs specified by the Nitrofen Assessment Team
b/ Derived in Table 1.
c/ Extent of use of each program specified by the Nitrofen Assessment Team.

Table 3. Per Acre Costs of Alternative Weed Control Programs on Broccoli in California

Weed Control Program a/	Application Rate (lbs. a.i.)	Cost per lb. a.i. ($) b/	Herbicide Treatment Cost per Acre ($) c/	Cultivation Costs per Acre ($) e/	Hoeing Costs f/		Total Weed Control Cost per Acre ($)
					Thinning	Weeding	
cultural controls #1	--	--	--	24.50	105.00	52.50	182.00
CDEC + DCPA pre. tank mix	2 + 4.5	6.63 + 6.72	51.50	21.00	52.50	52.50	177.50
trifluralin - pre. inc.	0.5	12.60	23.30 d/				
+ DCPA - pre.	4.5	6.72	38.24 / 61.54	21.00	52.50	52.50	187.54
DCPA pre. #1	4.5	6.72	38.24	21.00	78.75	52.50	190.49
CDEC pre.	2	6.63	21.26	21.00	65.63	52.50	160.39
DCPA pre. #2	4.5	6.72	38.24	21.00	78.75	65.63	203.62
cultural controls #2	--	--	--	24.50	105.00	68.25	197.75

a/ Control programs and application rates were developed by the Nitrofen Assessment Team. Assumes band herbicide treatments. Pre. = preplant application; pre-inc. = preplant soil incorporation; post. = postplant application.
b/ Based on 1981 pesticide prices reported in Galt et al., 1981, p. vii. Nitrofen cost based on 1980 price.
c/ Includes herbicide application cost of $8.00 per acre for all treatments except as noted.
d/ Includes pre-plant soil incorporation cost at $17.00 per acre.
e/ Includes one cultivation at $10.50 per acre plus two at $7.00 per acre or three cultivations at $7.00 per acre.
f/ Assessment Team specified the amounts of plant thinning and weed hoeing required under the various programs.

Table 4. Total Cost of Alternative Weed Control Programs Used on Broccoli in California - CDEC Available

Weed Control Program a/	Cost per Acre ($) b/	Number of Acres Treated c/	Total Cost ($)
cultural controls #1	182.00	21,131	3,846,000
CDEC + DCPA preemergence tank mix	177.50	29,455	5,228,000
trifluralin preemergence soil incorporation + DCPA preemergence	187.54	5,834	1,094,000
DCPA preemergence #1	190.49	13,803	2,629,000
CDEC preemergence	160.39	925	148,000
		71,148	12,945,000

a/ Programs specified by the Nitrofen Assessment Team.
b/ Derived in Table 3.
c/ Extent of use of each program specified by the Nitrofen Assessment Team.

Table 5. Total Cost of Alternative Weed Control Programs Used on Broccoli in California - CDEC Unavailable

Weed Control Program a/	Cost per Acre ($) b/	Number of Acres Treated c/	Total Cost ($)
cultural controls #1	182.00	21,131	3,846,000
DCPA preplant #2	203.62	29,455	5,998,000
trifluralin preplant soil incorporated + DCPA preplant	187.54	5,834	1,094,000
DCPA preplant #1	190.49	13,803	2,629,000
cultural controls #2	197.75	925	183,000
		71,148	13,750,000

a/ Programs specified by the Nitrofen Assessment Team.
b/ Derived in Table 3.
c/ Extent of use of each program specified by the Nitrofen Assessment Team.

References

Galt, Daniel, Barbara Albertson, Katherine Eckhouse and Gordon Rowe. 1981. Assessment of Tok® (Nitrofen) Suspension on Broccoli, Brussel Sprouts, Cabbage, Cauliflower and Celery Grown in California's Central and Southern Coastal Counties. Giannini Foundation/Cooperative Extension, University of California. June.

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SUMMARY OF PRELIMINARY BENEFIT ANALYSIS OF PREEMERGENT NITROFEN USE ON BRUSSELS SPROUTS

A. USE: Nitrofen use on Brussels Sprouts.

B. MAJOR PESTS CONTROLLED:

annual bluegrass	lambsquarters	nettle	shepherdspurse
crabgrass	malva	pigweed	spergularia
goosefoot	nightshade	purslane	

C. ALTERNATIVES:

Major registered chemicals: CDEC, DCPA, Trifluralin

Comparative efficacy/performance: Use of alternative weed control methods would maintain current yields and quality i the short run. In the longer run, yields may decline due to anticipated buildup of weed populations.

Comparative costs: N/A

D. EXTENT OF USE: None. The Assessment Team projected little or no nitrofen use under the program proposed by Rohm and Haas.

E. ECONOMIC IMPACTS:

User: None

Market/Consumer: None

Macroeconomic: None

F. SOCIAL/COMMUNITY IMPACTS: None

G. LIMITATIONS OF ANALYSIS: Estimates of comparative efficacy of nitrofen and alternative herbicides were based on the experience of weed science specialists and not on field data.

There are insufficient biological and economic data to assess potential long run impacts of increasing weed pressure following a nitrofen suspension.

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July 1981

PRELIMINARY BENEFIT ANALYSIS OF NITROFEN USE ON BRUSSELS SPROUTS

Current Use Analysis

EPA Registration of Nitrofen and Alternativies

Nitrofen is a selective herbicide registered for use on brussels sprouts to control the following weeds: annual bluegrass, crabgrass, goosefoot, lambsquarters, malva, nightshade, nettle, pigweed, purslane, shepherdspurse, and spergularia (EPA, 1980). Nitrofen, prior to the voluntary market removal, was applied to brussels sprouts at postemergence, usually in sequence with a preplant incorporation of trifluralin or CDEC and a preemergent application of DCPA (USDA/EPA/States, 1980). Although available in a emulsifiable concentrate formulation (25EC), nitrofen was usually applied to brussels sprouts in a wettable powder formulation (50 WP). The label directions for nitrofen use in the wettable powder formulation called for a single postermergence application at 4 to 6 pounds a.i. per acre mixed with 40 to 60 gallons of water. In the emulsifiable concentrate formulation, the amended label calls for a single preemergence application at 3 to 6 pounds a.i. per acre mixed with 40 to 60 gallons of water.

The major alternative herbicides registered for preplant or preemergent application on brussels sprouts are trifluralin, DCPA, CDEC, nitralin, and bensulide.

Extent of Nitrofen Use

Approximately 5,733 acres of brussels sprouts are currently grown in the United States (1977 - 1979 average). About 813 acres (14 percent) were treated with nitrofen prior to its voluntary removal from the market in 1980 (USDA/EPA/States, 1980). Applications were made after transplanting seedings into the field. The amended registration request submitted by Rohm and Haas does not allow nitrofen use on transplanted brussels sprouts.

Currently almost all California brussels sprouts are transplanted and the weed control program for most growers has been to cultivate in a manner to throw dirt in order to bury emerging weeds. The nitrogen assessment team estimated that growers who had been using nitrofen would shift to a weed control program involving cultivations to bury emerging weeds rather than shift a a program involving direct seeding and a preemergence use of nitrofen.

Hence, without any projected use of nitrofen on brussels sprouts, there is no need to conduct an economic analysis of the impact of a loss of pre-emergence nitrofen use.

SUMMARY OF PRELIMINARY BENEFIT ANALYSIS OF PREEMERGENT NITROFEN USE ON CABBAGE

A. USE: Nitrofen use on California cabbage

B. MAJOR PESTS CONTROLLED:

annual bluegrass	lambsquarters	nettle	shepherdspurse
crabgrass	malva	pigweed	spergularia
goosefoot	nightshade	purslane	

C. ALTERNATIVES:

Major registered chemicals: DCPA, CDEC, and trifluralin

Comparative efficacy/performance: Use of alternative weed control methods would maintain current yields and quality in the short run. In the longer run, yields may decline due to anticipated buildup of weed populations.

Comparative costs:

County	Nitrofen Program Cost/Acre ($)	Alternative Program Cost/Acre ($)	Difference in Cost/Acre ($)
Santa Barbara	103-129	190-223	87-94
Monterey	103-129	189-221	86-92
Ventura	141	191-223	50-82
Other	159	216	57

D. EXTENT OF USE:

Acres Treated	% of U.S. Cabbage Average	Quantity of Nitrofen Used Annually (lb. a.i.)
4,153	4	8,306

E. ECONOMIC IMPACTS:

User: The cancellation of nitrofen and the substitution of alternative herbicides for weed control on direct seeded cabbage would result in higher treatment costs for growers. In the short run, the total increase of production costs on the affected acreage in California (8,306 acres) would range from about $313 to $331 thousand per year, an increase of about 3 percent in annual production costs.

In the long run the weed population may increase and eventually affect yields and quality of cabbage output.

Market/Consumer: The use of alternative herbicides in place of nitrofen would have little or no impact on the industry supply or quality of output. Since the affected cabbage acreage represents only 4 percent of total U.S. cabbage output, the increased production costs would be expected to have no significant impact on retail prices.

Macroeconomic: No significant macroeconomic impact expected.

F. SOCIAL/COMMUNITY IMPACTS: Alternative weed control programs may require additional field labor. The increased demand for field labor may bid up wages and in some cases cause shortages of field labor.

The use of alternative weed control programs and the reallocation of land to other crops may lead to an increased demand for new farm equipment and other factors of production.

G. LIMITATIONS OF ANALYSIS: Estimates of comparative efficacy of nitrofen and alternative herbicides were based on the experience of weed science specialists and not on field data.

There are insufficient biological and economic data to assess potential long run impacts of increasing weed pressure following a loss of nitrofen.

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Preliminary Benefit Analysis of Nitrofen Use on California Cabbage

Current Use Analysis

EPA Registrations of Nitrofen and Alternatives

Nitrofen is a selective herbicide which was previously registered for preemergent and postemergent use on cabbage for the control of a variety of weeds including: annual bluegrass, crabgrass, goosefoot, lambsquarters, malva, nightshade, nettle, pigweed, purslane, shepherdspurse, and spergularia (EPA, 1980). Under the terms of the amended registration, nitrofen will be applied to cabbage grown only in California on a preemergence basis only. Many of the nitrofen treatments are expected to be in combination with other herbicides such as DCPA, CDEC, or trifluralin. The label directions for nitrofen use in the emulsifiable concentrate formulation (25EC) call for a single preemergence spray at 3 to 6 pounds active ingredient per acre mixed with 40 to 60 gallons of water.

The major alternative herbicides registered for use on cabbage at preemergence are DCPA, CDEC, and trifluralin. The future status of CDEC is uncertain, since the only domestic producer has stopped production of the pesticide. There are, however, sufficient stocks of CDEC on hand for at least one more crop year.

Extent of Nitrofen Use

About 8,500 acres of cabbage are currently under cultivation in California which accounts for about 9 percent of the total U.S. cabbage acreage (USDA, 1981). Six major cabbage producing counties accounted for nearly 80 percent of California cabbage acreage (Table 1), of which about 4,153 acres were treated with nitrofen. Nitrofen is expected to be applied on direct seeded acres as a band application at 2 pounds of active ingredient (a.i.) per acre. An estimated 10,000 pounds a.i. of nitrofen are expected to be applied to cabbage in California. It was estimated that usage would be about the same as the former nitrofen program.

Economic Impact Analysis

Farm Impacts

Production Cost Changes

The nitrofen weed control program for cabbage would include a preemergence application of nitrofen, frequently in combination with CDEC, DCPA and trifluralin. Hoeing and cultivation would also be used on all acres treated with nitrofen (Nitrofen Assessment Team, 1981). Weed control costs ranged from about $103 to $159 per acre (Table 2). These costs usually include four cultivations and hand hoeing to thin and control those weeds which escape chemical control.

If nitrofen were not available, growers would be expected to substitute alternative programs using trifluralin, DCPA, CDEC, and nonchemical controls (Table 4). In order to compensate for the reduced effectiveness of the alternative herbicides, growers would use additional cultivations and hand hoeings during the growing season (Nitrofen Assessment Team, 1981). In addition, growers would have to increase the seeding rate to insure adequate competition with the emerging weeds and to compensate for the loss of plants during early mechanical and hand hoeing weed control. The seeding cost would increase from $30 per acre with nitrofen to $60 per acre without nitrofen (Table 4). The weed control cost of using alternative weed control programs on the affected acreage is estimated to range from $189 to $223 per acre (Table 5). The total weed control cost would increase from $534,700 with nitrofen to $847,700 without nitrofen but with CDEC.

If both nitrofen and CDEC were not available, weed control costs would range from $189 to $223 per acre (Table 5). Total weed control costs would increase to $866,200 without nitrofen or CDEC (Table 5).

Based on 1980 budget estimates for cabbage grown in California, a $64 to $86 increase in costs resulting from the use of alternative weed control programs would represent an increase of about 3 percent in total production costs. This cost increase would represent about 49 percent of estimated net returns (University of California, 1980).

[illegible] not available, growers would be expected [illegible]

using [illegible] NCIA, CDEC, and agrochemical controls

to compensate for the reduced effectiveness of the

[illegible] growers would use additional cultivation and hand

growing season (Nitrofen Assessment Team 1981). In

[illegible] would have to increase the seeding rate to insure adequate

with the emerging weeds [illegible] of the loss of [illegible]

[illegible] and hand [illegible] weed control. The seeding [illegible]

[illegible] per acre with nitrofen [illegible] per acre without

[illegible] 6). The weed control cost of using alternative weed control

the affected acre [illegible] from [illegible] to [illegible] per

[illegible] The total weed control cost would increase from [illegible]

to [illegible],700 without nitrofen [illegible] CDEC.

[illegible] nitrofen and CDEC were not available, weed control costs would

to $223 per acre (Table 5). [illegible] weed control costs would

[illegible] without nitrofen or CDEC (Table 5).

[illegible] 1980 budget estimates for cabbage grown in California, a [illegible]

increase in costs resulting from the use of alternative weed control

would represent an increase of about 3 percent in total production

[illegible] cost increase would represent about [illegible] percent of estimated net

[illegible] of California, 1980).

Yield and Revenue Impacts

The use of alternative weed control programs in the place of nitrofen would have no adverse affect on the quality of the cabbage marketed. Short term output levels would also be maintained if alternative weed control programs were used on the impacted California cabbage acreage. Therefore, the only net revenue impact would be an increase of the production cost of about $313 to $331 thousand for the affected areas in California.

In the longer run, it is expected that increased weed pressures would increase the cost of maintaining weed populations at levels that circumvent significant yield or quality losses. Since California produces about 9 percent of total U.S. cabbage and about 49 percent of California cabbage would be treated with nitrofen, it is unlikely that significant production cost increases could be passed on in the market. Therefore, it is likely that some producers would shift to alternative crops.

Consumer Impacts

In the short run, any impact to the consumer would be minor since total production costs are expected to increase by about 3.6 percent on only 4 percent of the total U.S. acreage with no significant yield or quality impacts. In the longer run, it is not clear what the impact of some producers shifting out of cabbage production would be. If other regions of the country could produce the additional cabbage without major cost increases, the impacts would be minor. Nitrofen was used on about 44

percent of U.S. cabbage prior to its removal from the market by Rohm and Haas. Therefore, it is expected that the proposed program would provide California producers with a cost of production advantage relative to other cabbage producers; the loss of nitrofen would reduce this advantage. It is likely that, over time, a combined loss of nitrofen in California and the rest of the country could result in retail price increases of an undetermined magnitude.

Limitations of Analysis

1. There are insufficient biological and economic data for long run estimates of potential impacts of a possible regulatory action on nitrofen.

References

Galt, Daniel, Barbara Alberston, Katherine Eckhouse and Gordon Rowe. 1981. Assessment of TOK® (Nitrofen) Suspension on Broccoli, Brussel Sprouts, Cabbage, Cauliflower and Celery Grown in California's Central and Southern Coastal Counties. Giannini Foundation/Cooperative Extension, University of California. June.

Rowe, Gordon and Barbara Albertson. 1980. TOK® (Nitrofen), Cultural Practices for Crops, Economic Impacts (Draft). Cooperative Extension. University of California. Berkeley, California. July.

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U.S. Department of Commerce. 1974. Census of Agriculture: California. Bureau of the Census. Washington, D.C.

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Table 1. Cabbage acreage and acres treated with nitrofen in California, by county

County	Acres planted a/	Direct seeded acres b/	Percent of directed seeded acres treated b/	Acres treated
Monterey	2,000	1,000	100	1,000
Ventura	1,800	1,600	90	1,440
Santa Barbara	1,400	1,400	70	980
Imperial	660	528	65	343
Riverside	590	472	65	307
San Diego	320	160	52	83
Total	6,770	5,160	80	4,153

a/ California Crop and Livestock Reporting Services. California Vegetable Crops, Annual Summaries, 1979.

b/ USDA/EPA/States, Nitrofen Assessment Team.

Table 2. Description of nitrofen weed control programs for cabbage in California, by county a/

County	Program	Rate per acre	Material cost per lb. of a.i.	Cost per acre: Material and application a/	Cultivation c/	Thin and hoe d/	Hoe d/	Total
		(lbs a.i.)		Dollars				
Monterey	1-Nitrofen (Pre)	2	7.42	22.84	28.	52.50	0	103.34
	2-Nitrofen (Pre)	2	7.42	48.27	28.	52.50	0	128.77
	+ DCPA (Pre)	4.5	5.65					
	3-Trifluralin(PPI)	0.25	10.07	42.36	28.	52.50	0	122.86
	+ Nitrofen (Pre)	2.	7.42					
Ventura	4-Nitrofen (Pre)	2	7.42	22.84	28.	52.50	37.50	140.84
Santa Barbara	5-Nitrofen (Pre)	2	7.42	22.84	28.	52.50	0	103.34
	6-Nitrofen (Pre)	2	7.42	48.27	28.	52.50	0	128.77
	+ DCPA (Pre)	4.5	5.65					
Imperial, Riverside, and San Diego	7-DCPA (Pre)	4.5	5.65	48.27	21.	52.50	37.50	159.27
	+Nitrofen (Pre)	2	7.42					

Pre - Preemergent application; Post - Postemergent application; PPI - Preplant incorporated.

a/ Nitrofen Assessment Team, 1981.

b/ Includes both material and application costs. Application cost is $8 per acre for preemergent or postemergent application as single ingredient or tank-mix, and is $17 per acre for the preplant incorporated application.

c/ Cultivation lost is $7 per acre each time.

d/ Hoeing cost is $7.50 per hour.

able 3. Total cost of nitrofen weed control programs used on cabbage in California, by county

County	Weed control program a/	Acres treated b/		Cost per acre a/	Total weed control cost
		Percent	Acres	($)	($1,000)
onterey	1-Nitrofen (Pre)	70	700	103.34	72.3
	2-Nitrofen (Pre) + DCPA (Pre)	20	200	128.77	25.8
	3-Trifluralin (PPI) + Nitrofen (Pre)	10	100	122.86	12.3
	Total	100	1,000	110.38	110.4
entura	1-Nitrofen (Pre)	100	1,440	140.84	202.8
	Total	100	1,440	140.84	202.8
anta Barbara	1-Nitrofen (Pre)	86	840	103.34	86.8
	2-Nitrofen (Pre) + DCPA (Pre)	14	140	128.77	18.0
	Total	100	980	106.94	104.8
mperial, Riverside, and San Diego	1-DCPA (Pre) +Nitrofen (Pre)	100	733	159.27	116.7
	Total	100	733	159.27	116.7

a/ Table 2.
b/ Table 1.

SHORT RUN ECONOMIC ANALYSIS OF PREEMERGENT NITROFEN USE IN CALIFORNIA

United States Department of Agriculture
United States Environmental Protection Agency
Benefits and Field Studies Division
and
University of California

Washington, D.C. July, 1981

CONTENTS

SUMMARY

If the April 1981 application by Rohm and Haas to amend the registration for nitrofen is denied, increased production costs would reduce short term income for impacted California vegetable producers (Table 1). The loss of income for nitrofen users was estimated under two scenarios with CDEC either available or not available as an alternative control.[1/] The total short term income loss for nitrofen users over both scenarios was estimated to range from $12.39 million (with CDEC available) to $13.334 million (with CDEC unavailable): $11 to $11.8 million for broccoli; $ .313 to $ .331 million for cabbage; $1.03 to $1.15 million for cauliflower; and $ .047 to $ .053 million for celery. Farm income losses are not expected for California brussels sprout growers, since little preemergent nitrofen use is anticipated. Non-users of nitrofen may experience windfall economic gains, but data were not available for such estimates.

Approximately 94,000 California acres are expected to be treated annually with 189,000 pounds a.i. nitrofen (Table 1). Base acre treatments and nitrofen usage by different sites are as follows:

Sites	Expected Base Acre Treatments	Percent of California Acres	Percent of U.S. Acres	Expected Pounds A.I. Applied	Expected % of Total Nitrofen Usage
broccoli	71,148	98	91	144,000	76.2
brussels sprouts	negligible	less than 1.0	less than 1.0	negligible	negligible
cabbage	4,153	49	4	8,306	4.4
cauliflower	15,714	48	35	31,428	16.6
celery	2,569	12	7	5,138	2.7
Total	93,584	--	--	188,872	100

1/ CDEC is no longer being manufactured; existing supplies may last one more year. California is currently reviewing the continued use of CDEC in the state.

Table 1. Overall Summary of the Short Run Economic Impacts of Preemergent Nitrofen Use in California

Site	Expected Extent of Use: Pounds A.I. Applied	Expected Extent of Use: Acres Treated	Percent of California Acres	Percent of U.S. Acres	Alternative Controls a/	Producer Income Loss (Gain) (Short Run): Million Dollars	Producer Income Loss (Gain) (Short Run): Dollars Per Acre	Consumer Economic Impact (Short Run)
Broccoli	144,000	71,148	98	91	DCPA, CDEC, trifluralin, cultural methods	$11-$11.8 million	$155-$166 (7.3-13.6%)	Higher retail prices anticipated
Brussels Sprouts	little or no use		N/A	N/A	DCPA, CDEC, trifluralin, cultural methods	None	N/A	None
Cabbage	8,306	4,153	49	4	DCPA, CDEC, trifluralin, cultural methods	$.313-$.331 million	$ 86-$ 94	No significant impact
Cauliflower	31,428	15,714	48	35	DCPA, CDEC, cultural methods	$1.03-$1.15 million	$ 65-$ 73 (2-3%)	No significant impact
Celery	5,138	2,569	12	7	prometryne, chloroxuron, crop oil	$.047-$.053	$ 15-$ 23 (<1%)	No significant impact
All Sites	188,872	93,584	—	--	—	$12.39-$13.334 million	—	--

a/ The alternative herbicides will frequently be used in combination with each other and in control programs which include cultural methods (mechanical cultivation, land hoeing).

Preemergent use of nitrofen on California vegetable crops is expected to vary considerably by site. Although nitrofen use on brussels sprout acreage is expected to be negligible, the base acres treated are expected to vary from 12 to 49 percent for celery, cauliflower, and cabbage. At least 98 percent of the California broccoli acreage is expected to be treated with nitrofen.

If the application for the amended registration of nitrofen is denied, the decline in short term income of all impacted California vegetable growers would range from $12.39 million (with CDEC available) to $13.334 million (without CDEC available) (Table 1). Longer term income changes or possible economic windfall gains to nonimpacted growers could not be estimated with available data. The ramifications of increases term changes in weed populations shifts in crop production patterns, or the development/availability of alternative controls could not be accurately quantified. However, without a new alternative control, weed populations would be expected to increase and result in cost of production increases beyond those estimated in this report.

Since short term crop output losses are not expected if the request for the amended registration for nitrofen is denied, consumer retail price impacts would be affected primarily by increased crop production costs shifting the market supply functions. Though not quantified, the largest short term retail price increases would be expected for those sites that have both large percentage increases in per acre production costs as well as a large proportion of the U.S. output affected by the nitrofen regulatory decision. Thus, the crops with greatest potential for retail price increases are broccoli and to a lesser extent, cauliflower.

Longer term consumer price impacts could not be evaluated with existing data. The implications of uncertain increases in weed control costs, possible yield and/or quality losses, shifts in crop production patterns, or the development/availability of alternative controls could not be accurately assessed.

INTRODUCTION

Rohm and Haas Company submitted an application to EPA on April 17, 1981 for the purpose of amending the registration of nitrofen (TOK®). Rohm and Haas has requested to limit nitrofen use to the EC25 formulation as a preemergent weed control for the five following California use sites: broccoli, brussels sprouts; cabbage; cauliflower; and celery. Any nitrofen usage would also be limited to direct seeded cropping schemes and application by firms or individuals under contractual agreement with Rohm and Haas.

For some of the California use sites, a denial of the amended nitrofen registration would be expected to have economic impacts of increasing production costs and thereby reducing growers' income. However, cost effective control programs are available for some sites; hence, negligible economic impacts would be anticipated in these situations.

This report examines the short run implications of a denial of the amended registration application. Qualitative estimates of the longer run ramifications are provided whenever possible.

SCOPE

The short run impacts of a possible denial of an amended nitrofen registration are the primary objectives of this study. The California nitrofen use sites that were analyzed include: broccoli, brussels sprouts, cabbage, cauliflower, and celery.

The economic analyses focus on the short run changes in growers' income that would result from such an action. Consumer, macroeconomic, and social/community impacts were primarily limited to qualitative assessments.

The economic impact estimates were derived by the use of partial budgeting techniques. Information on acres treated with nitrofen, alternative weed control input requirements, and comparative evaluations between nitrofen and alternatives were provided by USDA/State biologists; EPA biologists provided the team with information on registered controls, use practices, and use limitations by site. Crop acreage, production, and commodity prices were based mostly on 1980 data.

Economic estimates for the long run were limited to qualitative assessments since information on longer term producer and market adjustments were not readily available.

SUMMARY OF PRELIMINARY BENEFIT ANALYSIS OF NITROFEN USE ON BROCCOLI

Nitrofen use on broccoli (California only).

OR PESTS CONTROLLED:

annual bluegrass	lambsquarters	nettle	shepherdspurse
crabgrass	malva	pigweed	spergularia
goosefoot	nightshade	purslane	

ERNATIVES:

jor registered chemicals: DCPA, CDEC, and trifluralin

n-chemical controls: Mechanical cultivation and hand hoeing.

mparative efficacy/performance: Use of alternative weed control methods would maintain current yields and quality in the short run. In the longer run, yields may decline due to anticipated cumulative buildup of weed populations.

mparative costs:

Nitrofen Program Cost/Acre ($)	Alternative Program Cost/Acre ($)	Difference in Cost/Acre ($)
43-135	232 - 243	155 - 166

Nitrofen program includes use of nitrofen in sequence with DCPA, CDEC, or trifluralin, along with 3 mechanical cultivations and 1 hand hoeing. Alternative programs may include use of 2 herbicides, such as DCPA, CDEC, or trifluralin. Alternative programs also include greater seeding rates and additional mechanical cultivations and hand hoeings.

ENT OF USE:

Acres Treated	% of U.S. Broccoli Acreage	Quantity of Nitrofen Used Annually (lb. a.i.)
71,148	91	144,000

ONOMIC IMPACTS:

oducer: In the short run, the estimated 405 growers currently using nitrofen on broccoli would incur annual production cost increases ranging from about $11.0 to $11.8 million. Production costs would increase by about 7 to 13 percent on the affected acreage, or by $27,000 to $29,000 annually on the average affected farm of 175 acres.

These cost impacts would reduce grower incomes in the short run. In the long run, the costs would probably be shifted forward in the market since over 90% of U.S. acres will be affected. Some of the impacted growers would be expected to reallocate their land to other crops less affected by a nitrofen regulatory action.

rket/Consumer: The use of alternative herbicides in place of nitrofen would maintain broccoli availability and quality in the short run. Retail prices would be expected to rise as increased production costs are passed on to consumers. In the longer run, higher grower prices would tend to stimulate new and expanded production which would increase the supply of broccoli and reduce the initial impact on retail prices. However, increased problems with weed competition are expected in future years, which would tend to reduce yields.

IAL/COMMUNITY IMPACTS: Alternative weed control programs may require additional field labor. The increased demand for field labor may bid up wages and in some cases cause shortages of field labor.

The reallocation of land to other crops may lead to an increased demand for new farm equipment and other factors of production.

ITATIONS OF ANALYSIS: Estimates of comparative efficacy of nitrofen and alternative herbicides were based on the experience of weed science specialists and not on field data.

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July, 1981

Preliminary Benefit Analysis of Nitrofen Use on California Broccoli

Current Use Analysis

EPA Registrations of Nitrofen and Alternatives

Nitrofen is a selective herbicide which was previously registered for preemergent and postemergent use on broccoli for the control of a variety of weeds including: annual bluegrass, crabgrass, goosefoot, lambsquarters, malva, nightshade, nettle, pigweed, purslane, shepherdspurse, and spergularia (EPA, 1980). Under the terms of the amended registration, nitrofen will be applied to broccoli grown only in California on a preemergence basis only. Many of the nitrofen treatments are expected to be in combination with other herbicides such as DCPA, CDEC, or trifluralin. The label directions for nitrofen use in the emulsifiable concentrate formulation (25EC) call for a single preemergence spray at 3 to 6 pounds active ingredient per acre mixed with 40 to 60 gallons of water.

The major alternative herbicides registered for use on broccoli at preemergence are DCPA, CDEC, and trifluralin. The future status of CDEC is uncertain, however, since the only domestic producer has stopped production of this pesticide. There are, however, sufficient stocks of CDEC on hand for at least one more crop year.

Extent of Nitrofen Use

Broccoli represents the most important use for nitrofen, both in terms of annual acreage treated and pounds of active ingredient used. Of approximately 78,450 acres of broccoli currently grown in the United States (1980 acreage) about 72,600 are in California (93%) (U.S. Department of Agriculture, 1981). About 71,148 acres (98 percent) of California's crop are expected to be treated with nitrofen if it is available (Nitrofen Assessment Team, 1981). The acreage likely to be treated in California amounts to about 91% of the total U.S. acreage. A total of about 144,000 pounds active ingredient of nitrofen would be used on broccoli annually under the amended registration.

There are an estimated 405 farms that will use nitrofen on broccoli. The average farm size is about 175 acres (U.S. Department of Commerce, 1974).

Farm Impacts

Production Cost Changes

The typical nitrofen weed control program for broccoli would include a preemergence application of nitrofen, frequently in combination with other herbicides. On about 91 percent of the treated acreage (about 64,750 acres), nitrofen would be used in combination with hoeing and cultivation to control weeds. On the remaining 10 percent of the acreage (about 6,400 acres) nitrofen would be used in various treatment schedules with CDEC (if available), DCPA, and trifluralin (Nitrofen Assessment Team, 1981).

The cost of these various nitrofen treatments would range from about $44 to $135 per acre (Table 1). In addition to herbicide treatments, the nitrofen weed control program would usually include three mechanical cultivations at a cost of $7 per acre per cultivation and one hand hoeing operation per season at a cost of $52.50 per acre (Nitrofen Assessment Team, 1981). The total cost of the nitrofen programs is estimated at $5.5 million annually or $77 per average acre (Table 2).

The use of alternative herbicide combinations would provide less effective weed control than herbicide treatments using nitrofen. In order to compensate for the reduced effectiveness of alternative treatments, growers would typically increase the number of hand hoeing operations by 1 or 2 per season (Nitrofen Assessment Team, 1981). Along with these additional field operations, the use of alternative herbicides would usually require growers to increase their seeding rate by about 5 ounces of seed per acre in order to compete with increased weed populations. The increased seeding rates would increase production costs by $50 per acre (Nitrofen Assessment Team, 1981).

If nitrofen use on broccoli were cancelled, growers would likely substitute alternative herbicides for nitrofen at preemergence. If CDEC is available, the principal alternative herbicide programs expected to be used include: DCPA and CDEC (on about 40 percent of the impacted acreage), and DCPA alone (on about 20 percent of the impacted acreage). A cultural controls (hoeing and cultivation) program would be used on about 30% of the affected acres. The costs of these alternative programs range from about $160 to $191 per acre (Table 3). On an annual basis (for the total 71,148 impacted acres), the use of alternative herbicides (including CDEC) and cultural methods would result in weed control costs of about $12.95 million or $182 per average affected acre (Table 4). This represents a total increase of $7.45 million annually or $105 per acre over weed control costs with nitrofen.

If CDEC is not available for use on broccoli growers will likely utilize treatment programs involving trifluralin and DCPA (on about 8 percent of the affected acres), DCPA alone (on 61% of the acreage), and a cultural controls (hoeing and cultivation) program (on about 31% of the affected acres). The total cost of these programs is estimated at about $13.75 million annually or $193 per average affected acre (Table 5). This represents an increase in weed control costs with nitrofen available of about $8.26 million annually or $116 per average affected acre.

The total increase in broccoli production costs if nitrofen is unavailable would be about $155 to $166 per acre (seeding rate cost increases of $50 plus the increased price of herbicide and cultural weed control treatments of about $105 (CDEC available) to $116 (CDEC unavailable) per average acre). Based on 1980 budget estimates for broccoli growers in California (University of California, 1980), the net increase in total production costs would represent an increase of from 7.3 to 13.6 percent on the impacted acreage (the range in impact is based on the ranges in production cost increases of $155 to $166 per acre and the total production cost estimates for broccoli which range from $1220 to $2137 per acre).

For the average California grower with 175 acres of broccoli, the use of alternative weed controls would increase annual production costs by about $27,000 to $29,000. The use of alternative weed controls on all of the impacted acreage (71,148 acres) would increase annual short term production costs by about $11 to $11.8 million.

The combined effectiveness of alternative herbicides and increased cultural weed control efforts will result in little or no adverse effects upon broccoli yield or quality if nitrofen is unavailable (Nitrofen Assessment Team, 1981). Since the cost impacts projected here reflect the growers' efforts to maintain current yield/quality levels, the increases in weed control costs would not be offset by revenue gains. Thus net reductions in grower incomes are anticipated, at least in the short run.

In the long run, the production cost increases could be shifted forward in the marketplace if the supply function for broccoli was affected. This would occur if the production cost effects were widespread among producers and/or if the cost impacts resulted in a reduction in broccoli plantings. Both of these factors are present in this case, since almost all (91%) of the broccoli grown in the U.S. will be treated with nitrofen if it is available and since the projected cost increases are of such a magnitude that some growers would probably plant alternative crops (particularly less labor intensive crops such as sugar beets and dry beans or cauliflower, which requires less weed management than broccoli)(Galt et al., 1981).

Consumer Impacts

In the short run, consumers of broccoli would probably not be noticeably affected by a regulatory action prohibiting usage of nitrofen. Alternative weed controls would maintain current yield and quality levels. Consumer impacts would therefore be limited to price increases resulting from a shifting forward of the production cost increases experienced by broccoli producers. Since almost all domestic production of broccoli would be affected, consumer level prices would be expected to increase to some extent. Some consumers would react to higher broccoli prices by substituting other vegetables for their current broccoli purchases.

Table 4. Description of nitrofen alternative weed control programs for cabbage in California, by county a/

County	Program	Rate per acre	Material cost per lb. of a.i.	Cost per acre: Material and application b/	Cultivation c/	Thin and hoe d/	Hoe d/	Total e/
		(lbs a.i.)		Dollars				
Monterey	With CDEC							
	1. DCPA (Pre) + CDEC (Pre)	4.5 + 2.0	5.65 + 5.30	44.03	28.	52.5	52.50	207.03
	2. Trifluralin (PPI)	0.25	10.07	19.52	28.	67.50	52.50	197.52
	3. DCPA (Pre)	4.5	5.65	33.43	28.	67.50	52.50	211.43
	4. No herbicide	-	-	-	28.	78.75	52.50	189.25
	Total							
	W/O CDEC							
	5. DCPA (Pre)	4.5	5.65	33.43	28.	67.50	52.50	211.43
	6. Trifluralin (PPI)	0.25	10.07	19.52	28.	67.50	57.75	202.77
	7. No herbicide	-	-	-	28.	105.00	57.75	220.75
	8. Trifluralin (PPI)	0.25	10.07	19.52	28.	67.50	52.50	197.52
	9. No herbicide	-	-	-	28.	78.75	52.50	189.25
Ventura	With CDEC							
	10. CDEC (Pre)	2.0	5.30	18.60	28.	63.75	52.50	192.85
	11. No herbicide	-	-	-	30.	78.85	52.50	191.25
	W/O CDEC							
	12. No herbicide	-	-	-	30.	78.75	52.50	191.25
	13. No herbicide	-	-	-	30.	95.63	67.50	223.13
Santa Barbara	W/O CDEC f/							
	14. No herbicide	-	-	-	29.	78.75	52.50	190.25
	15. DCPA (Pre)	4.5	5.65	33.43	28.	78.75	52.50	222.68
Imperial, Riverside, and San Diego	W/O CDEC f/							
	16. DCPA (Pre)	4.5	5.65	33.43	21.	78.75	52.50	215.68

Pre - Preemergent application; Post - Postemergent application; PPI - Preplant incorporated.

a/ Nitrofen Assessment Team, 1981.
b/ Includes both material and application costs. Application cost is $8 per acre for preemergent or postemergent application as single ingredient or tank-mix, and is $17 per acre for the preplant incorporated application.
c/ Cultivation cost is $7 per acre each time except for the first cultivation under the no herbicide options in Santa Barbara and Ventura Counties. The first cultivation increases to $8 in Santa Barbara County and $9 in Ventura County.
d/ Hoeing cost is $7.50 per hour.
e/ Includes $30.00 per acre increased seeding cost to allow for better competition with emerging weeds.
f/ CDEC under either scenario is not expected to be used as an alternative.

le 5. Total cost of of alternative weed control programs (without nitrofen) on cabbage in California, by county

County	Weed control program a/	Acres treated b/		Weed control cost/acre a/	Total weed control cost
		Percent	Acres	$	$1,000
terey	With CDEC				
	1. DCPA (Pre) + CDEC (Pre)	50	500	207.03	103.5
	2. Trifluralin (PPI)	20	200	197.52	39.5
	3. DCPA (Pre)	20	200	211.43	42.3
	4. No herbicide	10	100	189.25	18.9
	Total	100	1,000	204.20	204.2
	W/O CDEC				
	1. DCPA (Pre)	30	300	211.43	63.4
	2. Trifluralin (PPI)	10	100	202.77	20.3
	3. No herbicide	30	300	220.75	66.2
	4. Trifluralin (PPI)	20	200	197.52	39.5
	5. No herbicide	10	100	189.25	18.9
	Total	100	1,000	208.30	208.3
tura	With CDEC				
	1. CDEC (Pre)	33	475	192.85	91.6
	2. No herbicide	67	965	191.25	184.6
	Total	100	1,440	191.81	276.2
	W/O CDEC				
	1. No herbicide	67	965	191.25	184.6
	2. No herbicide	33	475	223.13	106.0
	Total	100	1,440	201.81	290.6
ta Barbara	W/O CDEC c/				
	1. No herbicide	29	280	190.25	53.3
	2. DCPA (Pre)	71	700	222.68	155.9
	Total	100	980	213.47	209.2
erial, verside, and n Diego	W/O CDEC c/				
	1. DCPA (Pre)	100	733	215.68	158.1
	Total	100	733	215.68	158.1

Table 4.
Table 1.
CDEC under either scenario is not expected to be used as an alternative

Table 6. Estimated economic impact of nitrofen use for weed control on cabbage in California, by county

County	Weed control cost with nitrofen a/	Weed control cost without nitrofen but with CDEC b/	Economic impact of nitrofen loss	Weed control cost without nitrofen or CDEC b/	Economic impact of CDEC loss	Economic impact of nitrofen and CDEC loss
	---$1,000---					
Monterey	110.4	204.2	93.8	208.3	4.1	97.9
Ventura	202.8	276.2	73.4	290.6	14.4	87.8
Santa Barbara	104.8	209.2	104.4	209.2	0	104.4
Imperial, Riverside and San Diego	116.7	158.1	41.4	158.1	0	41.4
Total	534.7	847.7	313.0	866.2	18.5	331.5

a/ Table 3.
b/ Table 4.

SUMMARY OF PRELIMINARY BENEFIT ANALYSIS OF PREEMERGENT NITROFEN USE ON CAULIFLOWER

USE: Nitrofen use on cauliflower.

MAJOR PESTS CONTROLLED:

annual bluegrass	lambsquarters	nettle	shepherdspurse
crabgrass	malva	pigweed	spergularia
goosefoot	nightshade	purslane	

ALTERNATIVES:

Major registered chemicals: DCPA, CDEC and trifluralin

Comparative efficacy/performance: Use of alternative weed control methods would maintain current yields and quality in the short run. In the longer run, yields may decline due to anticipated buildup of weed populations.

Comparative costs:

County	Nitrofen Program Cost/Acre ($)	Alternative Program Cost/Acre ($)	Difference in Cost/Acre ($)
Santa Barbara	156-174	246-262	88-90
Monterey	156-174	202-262	46-88
Other	156	202-228	46-72

EXTENT OF USE:

Acres Treated	% of U.S. Cauliflower Acreage (1980)	Quantity of Nitrofen Used Annually (lb. a.i.)
15,714	35	31,428

ECONOMIC IMPACTS:

User: The cancellation of nitrofen and the substitution of alternative herbicides for weed control on direct seeded cauliflower would result in higher treatment costs for growers. In the short run, the total increase of production costs on the affected acreage in California (15,714 acres) would range from about $1.0 to $1.1 million per year, an increase of about 3 percent in annual production costs. In the long run the weed population may increase and eventually affect yields and quality of cauliflower output.

Market/Consumer: The use of alternative herbicides in place of nitrofen would have little or no impact on the industry supply or quality of output. Since the affected cauliflower acreage represents only 35 percent of total U.S. cauliflower output, it is difficult to measure the impact that production cost increases would have on retail prices.

Macroeconomic: No significant macroeconomic impact expected.

SOCIAL/COMMUNITY IMPACTS: Alternative weed control programs would require additional field labor. The increased demand for field labor may bid up wages and in some cases cause shortages of field labor.

The use of alternative weed control programs and the reallocation of land to other crops may lead to an increased demand for new farm equipment and other factors of production.

LIMITATIONS OF ANALYSIS: Estimates of comparative efficacy of nitrofen and alternative herbicides were based on the experience of weed science specialists and not on field data.

There are insufficient biological and economic data to assess potential long run impacts of increasing weed pressure following a loss of nitrofen.

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July 1981

Preliminary Benefit Analysis of Nitrofen Use on Cauliflower in California

Introduction

The U. S. production of cauliflower for processing and fresh market sales is heavily concentrated in California. Between 1978-1981, approximately 33,000 acres were planted annually in California, producing an annual harvest of 3.1 million cwt., 77 percent of the total U. S. production (USDA, 1980). Nitrofen is a selective herbicide previously registered for preemergent and postemergent use on cauliflower to control a variety of weeds including cheeseweed, goosefoot, knotweed, morning glory, nettle, nightshade, pigweed, and purslane.

Under an amended registration, nitrofen use on cauliflower will be limited to preemergent use in California only. The wettable powder formulation previously used will be replaced by the emulsifiable concentrate.

The major alternative herbicides registered for preemergent use are CDEC and DCPA. Several of the nitrofen weed control programs are expected to utilize tank mixes of these materials with nitrofen. The only domestic producer of CDEC has stopped producing this product, making the future status of CDEC uncertain. Sufficient stocks of CDEC are on hand to last at least one more crop year. In the event CDEC becomes unavailable, the weed control programs utilizing it would be replaced by programs using DCPA and/or additional mechanical cultivation and hand hoeing.

Extent of Nitrofen Use and Alternatives

Under the amended registration, only direct-seeded cauliflower would be treated with nitrofen. Of the estimated 26,220 acres of direct-seeded cauliflower grown in seven California counties, 60 percent or about 15,714 acres would be treated with nitrofen (Table 1). Applied at a rate of 2.0 lbs. (a.i.) per acre, a total of

31,428 lbs. (a.i.) of nitrofen would be used on cauliflower under the amended registration. In 1974, there were 117 farms growing cauliflower in the six counties containing the cauliflower that would be treated with nitrofen (U. S. Department of Commerce, 1974).

Two of the weed control programs using nitrofen also use CDEC or DCPA. CDEC (plus nitrofen) would be used on 2,700 acres (Table 3). Applied at a rate of 2.0 lbs. (a.i.) per acre, a total of 5,400 lbs. (a.i.) of CDEC would be applied. DCPA (plus nitrofen) would be used on 6,930 acres (Table 3). Applied at a rate of 4.5 lbs. (a.i.) per acre, a total of 31,185 lbs. (a.i.) of DCPA would be applied. Thus, the total amount of herbicides applied using the nitrofen programs would be 31,428 lbs. (a.i.) of nitrofen, 5,400 lbs. (a.i.) of CDEC, and 31,185 lbs. (a.i.) of DCPA.

Without nitrofen and with CDEC, 7,796 acres would be treated with CDEC (alone or tank mixed with DCPA) at a rate of 2.0 lbs. (a.i.) per acre, totaling 15,592 lbs. (a.i.) . DCPA, alone or tank mixed with CDEC, would be applied to 10,440 acres at a rate of 4.5 lbs. a.i. per acre, totaling 46,980 lbs. a.i. of DCPA. Weed control programs using no herbicides would be used on 4,858 acres.

Without nitrofen or CDEC, 10,440 acres would be treated with DCPA (Table 3) at a rate of 4.5 lbs. a.i. per acre, totaling 46,980 lbs. a.i. of DCPA. Weed control programs using no herbicides would be used on the remaining 5,274 acres.

Farm Impacts

Production Cost Changes

The three nitrofen weed control programs (Table 2) utilize a preemergent application of nitrofen, either alone or tank mixed with CDEC or DCPA, three to four mechanical cultivations, and hand hoeing. The cost of these treatments range

from $155.84 to $174.26 per acre. The use of the three treatments is dictated by local weed conditions, thus the area treated with each program varies by county (Appendix Table 1). The total cost of the nitrofen programs is estimated at $2.6 million annually (Table 3), or an average of $165 per treated acre.

The alternative preemergent herbicides CDEC and DCPA do not control weeds as effectively as nitrofen. Substituting these herbicides for nitrofen requires an additional cultivation and/or additional hand hoeing (thin-hoeing the newly emerged cauliflower stand and hoeing the established cauliflower for weeds) to achieve the same degree of weed control provided by the nitrofen programs. The necessary increases in thin-hoeing and weed hoeing range from 25-100 percent, depending upon the weed infestations and the substitute herbicide(s) (Table 3). In addition to the extra cultivation and hoeing, the use of alternative weed control programs would require growers to increase the seeding rate by three ounces per acre to provide the plant population necessary to sucessfully compete with the increased weed populations. This increased seeding rate would increase planting costs by $30.00 per acre (Nitrofen Assessment Team, 1981).

The weed control programs that would be used if nitrofen were not available and CDEC were available range in cost from $202.38 to $246.40 per acre (Table 3). The use of these programs varies by county (Appendix Table 1) but for California as a whole, about 3 percent of the acreage would be treated with CDEC alone, 47 percent with CDEC + DCPA, 19 percent with DCPA alone, and 31 percent with no herbicides (Table 3). The total cost of the programs without nitrofen and with CDEC would be $3.6 million (Table 3), or an average of $230 per acre. The additional cost of these programs (compared to the nitrofen alternatives) totals $1.03 million (Table 3), or an average of $65 per acre. These additional costs include the $30 per acre extra seed cost.

The weed control programs that would be used if nitrofen and CDEC were not available range in cost from $202.38 to $262.05 per acre (Tables 2 and 3). While the use of these alternatives varies by county (Appendix Table 1), for California as a whole about 66 percent of the affected acreage would be treated with one of the DCPA programs (programs 6 and 7, Table 2) and 44 percent would be treated with programs using no herbicide (Table 3). The total cost of the programs without nitrofen or CDEC is estimated at $3.7 million (Table 3), or an average of $237 per acre. The additional costs of using these alternatives (compared to the nitrofen alternatives) is estimated at $1.15 million (Table 3), or an average of $73 per acre.

The total variable costs and total costs of producing fresh market cauliflower in Monterey County, California was estimated at $2,650 per acre and $3,190 per acre, respectively, in 1980 (University of California, 1980). The additional costs of the alternatives without nitrofen and with CDEC (an average of $65/acre) represent an increase of 2 percent in total variable costs. The $73 per acre average increase in weed control costs for the alternatives without nitrofen or CDEC (compared to the nitrofen alternatives) represents a 3 percent increase in total variable costs. Compared to estimated total cauliflower production costs of $3,190 per acre, the additional weed control costs represent an increase of 2 percent in total costs without nitrofen and with CDEC, and an increase of 2 percent in total costs without nitrofen or CDEC.

User Impact, By County

The treated acres and weed control programs used vary substantially by county (Appendix Table 1). The costs of various alternatives also vary substantially (Table 2). Hence, the user impact, a function of these variables, also varies substantially by county.

[illegible] programs that would be [illegible] percent, and [illegible]

[illegible] from $[illegible] to $[illegible] per acre (Tables [illegible] and 7). [illegible]

alternatives varies by county (Appendix Table [illegible]), [illegible]

[illegible] percent of the affected acreage would [illegible] treated with [illegible]

(programs 6 and 7, Table 7) and [illegible] percent would be treated with

herbicide (Table 8). The total [illegible] of the [illegible] alternatives [illegible]

is estimated at $1.7 million (Table [illegible]), [illegible] acreage [illegible]

additional costs of using these alternatives [illegible] in the

alternatives) is estimated at $1.[illegible] million (Table [illegible]) [illegible]

[illegible] variable costs and total costs of producing [illegible] in [illegible]

County, California was estimated at $[illegible] per acre and $[illegible] per acre

in 198[illegible] (University of California, 198[illegible]). The additional [illegible]

without nitrogen and with DBC [illegible] (on average [illegible]) represent [illegible]

percent in total variable costs. The $[illegible] per acre average increase

in costs for the alternatives without nitrogen or DBC (compared to the

[illegible]) represents a [illegible] percent increase in total variable costs.

[illegible] total cauliflower production costs of $[illegible] per acre, [illegible]

[illegible] costs [illegible] cause an increase of [illegible] percent in total costs

with DBC, and an increase of 2 percent in total costs with [illegible]

[illegible] Use Impacts, By County

[illegible] weed control programs used vary considerably by county

[illegible] costs of various alternatives also vary considerably

[illegible] these variables

The total cost of the nitrofen weed control programs is estimated to be $1.3 million on 7,650 acres in Monterey County, $0.7 million on 4,320 acres in Santa Barbara County, and $0.6 million on 3,744 acres in Orange, San Diego, Santa Cruz, and Ventura Counties (Appendix Table 5).

Without nitrofen and with CDEC, the total cost of the weed control programs is estimated at $1.8 million and $1.1 million, for Monterey and Santa Barbara counties respectively and $0.8 million for Orange, San Diego, Santa Cruz, and Ventura Counties. Compared to the nitrofen alternatives, the change in weed control costs is $482,000 ($63/acre) in Monterey County, $367,000 ($84/acre) in Santa Barbara County, and $183,000 ($49/acre) in Orange, San Diego, Santa Cruz, and Ventura Counties. Thus, the average per acre impact in Santa Barbara County is 1.7 times than greater in Orange, San Diego, Santa Cruz, and Ventura Counties, and 1.3 times the impact in Monterey County.

Without nitrofen or CDEC the total cost of weed control programs is estimated at $1.8 million for Monterey County, $1.1 million for Santa Barbara County, and $0.8 million for Orange, San Diego, Santa Cruz, and Ventura Counties. Compared to the nitrofen alternatives, the change in weed control costs is $530,000 ($69/acre) in Monterey County, $435,000 ($101/acre) in Santa Barbara County, and $186,000 ($50/acre) in Orange, San Diego, Santa Cruz, and Ventura Counties. Thus, the per acre user impact in Santa Barbara is: 1) twice the per acre impact in Orange, San Diego, Santa Cruz, and Ventura Counties, and 2) 1.4 times the per acre impact in Monterey County.

Revenue Impacts

In the short run the use of alternative herbicides and/or additional cultural weed control methods is expected to provide weed control equivalent to that achieved with the nitrofen weed control programs. No adverse effects on cauliflower yields or

quality are expected to accompany the use of weed control programs not utilizing nitrofen (Nitrofen Assessment Team). Thus, no changes in gross grower revenues are expected.

Net Grower Impacts

Since revenues are not expected to change due to using alternate weed control programs, the short run impact will be a reduction in net income equivalent to the increased weed control costs, assuming ceteris paribus conditions. If production costs in the long run can be passed forward in the marketplace, affected growers may maintain current cauliflower acreage. Shifts to other crops may occur, depending on the relative profitability of other crops. In the longer run weed populations are expected to increase. These increases would be expected to increase weed control costs and could have yield and/or quality impacts. Data were not available to estimate the magnitude of these longer term impacts.

Consumer Impacts

In the absence of expected changes in grower gross revenues, no significant consumer impacts can be expected in the short run. Consumer impacts could not be estimated for the longer run, since the magnitude of increased weed control costs and possible yield or quality losses were not available.

Limitations of Analysis

1. The analysis assumes sufficient labor for the additional hand hoeing and mechanical cultivations will be available.

2. The analysis assumes all costs and returns will remain constant in the short-run.

3. The analysis relies heavily on expert opinion rather than published research results or pesticide use survey results.

Table 1. Cauliflower production in California by county; area planted and estimated area treated with nitrofen preemergent, 1980

County	1980 a/ planted acres	Direct seeded acres b/	Percent direct seeded acres treated with nitrofen b/	Acres treated with nitrofen b/
Central Valley	1,700	1,360	0	0
Monterey	18,000	15,300	50	7,650
Orange	1,300	1,040	90	936
San Diego	600	480	90	432
Santa Barbara	6,000	5,400	80	4,320
Santa Cruz	1,300	1,040	90	936
Ventura	2,000	1,600	90	1,440
Total	30,900	26,220	60	15,714

a/ California Vegetable Crops Annual Summary, 1980. California Crop and Livestock Reporting Service.

b/ USDA/EPA/States Nitrofen Assessment Team 1981.

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Table 2. Description of weed control programs used on direct seeded cauliflower grown in California a/

Program	Rate per acre	Material cost per lb. (a.i.)	Cost per acre: Material + application b/	cultivation c/	Thin + hoe d/	Hoe d/	Total e/
No.	(lbs a.i.)		dollars				
1. Nitrofen	2	7.42	22.84	28.00	52.50	52.50	155.84
2. Nitrofen + CDEC	2 + 2	7.42 + 5.30	33.44	21.00	52.50	52.50	159.44
3. Nitrofen + DCPA	2 + 4.5	7.42 + 5.65	48.26	21.00	52.50	52.50	174.26
4. CDEC	2	5.30	18.60	28.00	78.75	65.63	220.98
5. CDEC + DCPA	2 + 4.5	5.30 + 5.65	44.02	28.00	78.75	65.63	246.40
6. DCPA I	4.5	5.65	33.42	28.00	78.75	65.63	235.80
7. DCPA II	4.5	5.65	33.42	28.00	105.00	65.63	262.05
8. No herbicide I	-	-	-	28.00	78.75	65.63	202.38
9. No herbicide II	-	-	-	28.00	105.00	65.63	228.63

a/ Includes Monterey, Orange, San Diego, Santa Barbara, Santa Cruz, and Ventura Counties.

b/ Includes an application cost of $8.00 per acre.

c/ Mechanical cultivation at $7.00 per acre per cultivation.

d/ Thin-hoeing and hoeing at $7.50 per hour.

e/ The cost of weed control programs that do not utilize nitrofen (programs 4-9) include $30.00 per acre for additional seed cost. The lack of preemergent use of nitrofen results in heavier weed infestations requiring additional seed at planting time to insure an adequate stand.

Table 3. Acres treated, cost per acre, and total costs of weed control programs used on direct seeded cauliflower in California a/

Weed control program	Cost per acre b/	Acres treated c/	Total cost
With nitrofen	($1.00)		($1,000)
1 Nitrofen	155.84	6,084	948
2 Nitrofen + CDEC	159.44	2,700	430
3 Nitrofen + DCPA	174.26	6,930	1,208
Total		15,714	2,586
Without nitrofen and with CDEC			
4 CDEC	220.98	416	92
5 CDEC + DCPA	246.40	7,380	1,818
6 DCPA I	235.80	3,060	722
8 No herbicide I	202.38	4,858	983
Total		15,714	3,615
Without nitrofen or CDEC			
6 DCPA I	235.80	3,060	722
7 DCPA II	262.05	7,380	1,934
8 No herbicide I	202.38	4,858	983
9 No herbicide II	228.63	416	95
Total		15,714	3,734
Change in control costs			
Without nitrofen and with CDEC	-	-	1,029
Without nitrofen or CDEC	-	-	1,148

a/ Includes Monterey, Orange, San Diego, Santa Barbara, Santa Cruz, and Ventura Counties.
b/ Table 2.
c/ USDA/EPA/States Nitrofen Assessment Team 1981.

References

University of California. 1980. Costs and Returns for Fresh Market Cauliflower in Monterey County. Cooperative Extension Budget Generator. Davis, California.

USDA 1981. Vegetables - - 1980 Annual Summary, Acreage, Yield, Production, Value. Crop Reporting Board, ESS. Washington, D. C.

U. S. Department of Commerce. 1974. Census of Agriculture California. Bureau of the Census. Washington, D. C.

USDA, USEPA and State of California, 1981, Nitrofen Assessment Team.

Appendix Table 1. Acres of direct seeded cauliflower treated with various weed control programs under three regulatory options in California, by county.

County	Regulatory option	Treatment a/	Percent of direct seeded acres treated b/	Acres treated
Monterey	With nitrofen	1	10	1,530
		3	40	6,120
	Without nitrofen and with CDEC	5	20	3,060
		6	20	3,060
		8	10	1,530
	Without nitrofen or CDEC	6	20	3,060
		7	20	3,060
		8	10	1,530
Santa Barbara	With nitrofen	1	15	810
		2	50	2,700
		3	15	810
	Without nitrofen and with CDEC	5	80	4,320
	Without nitrofen or CDEC	7	80	4,320
Orange, San Diego, Santa Cruz, Ventura	With nitrofen	1	90	3,744
	Without nitrofen and with CDEC	4	10	416
		8	80	3,328
	Without nitrofen or CDEC	8	80	3,328
		9	10	416

a/ Table 2.
b/ Nitrofen Assessment Team, 1981.
c/ Percentage of direct seed acreage times direct seeded acres in county. Direct seeded acres by county: Monterey - 15,300 acres; Santa Barbara - 5,400 acres; Orange, San Diego, Santa Cruz, Ventura Counties - 4,160 acres (Table 1).

Appendix Table 2. Acres treated, cost per acre, and total costs of weed control programs used on cauliflower in Monterey County, California

Weed control program	Cost per acre a/	Acres treated b/	Total cost
	($)		($1,000)
With nitrofen			
1 - nitrofen	155.84	1,530	238
3 - nitrofen + DCPA	174.26	6,120	1,066
Total		7,650	1,304
Without nitrofen, with CDEC			
5 - CDEC + DCPA	246.40	3,060	754
6 - DCPA I	235.80	3,060	722
8 - Cult I	202.38	1,530	310
Total		7,650	1,786
Without nitrofen or CDEC			
6 - DCPA I	235.80	3,060	722
7 - DCPA II	262.05	3,060	802
8 - Cult I	202.38	1,530	310
Total		7,650	1,834

a/ Table 2, column 7.
b/ Nitrofen Assessment Team, 1981.

Appendix Table 3. Acres treated, cost per acre, and total costs of weed control programs used on cauliflower in Santa Barbara County, California

Weed control program	Cost per acre a/	Acres treated b/	Total cost
	($)		($1,000)
With nitrofen			
1 - nitrofen	155.84	810	126
2 - nitrofen + CDEC	159.44	2,700	430
3 - nitrofen + DCPA	174.26	810	141
Total		4,320	697
Without nitrofen, with CDEC			
5 - CDEC + DCPA	246.40	4,320	1,064
Without nitrofen or CDEC			
7 - DCPA II	262.05	4,320	1,132

a/ Table 2, column 7.
b/ Nitrofen Assessment Team, 1981.

Appendix Table 4. Acres treated, cost per acre, and total costs of weed control programs used on California cauliflower in Ventura, Orange, Santa Cruz, and San Diego Counties, California

Weed control program	Cost per acre	Acres treated	Total cost
	($)		($1,000)
With nitrofen			
1 - nitrofen	155.84	3,744	583
Without nitrofen, with CDEC			
4 - CDEC	220.98	416	92
8 - Cult I	202.38	3,328	674
Total		3,744	766
Without nitrofen or CDEC			
8 - Cult I	202.38	3,328	674
9 - Cult II	228.63	416	95
Total		3,744	769

a/ Table 2, column 7.
b/ Nitrofen Assessment Team, 1981.

	Acres	Total cost
	treated	

Appendix Table 5. Total cost of alternate weed control programs and production cost impact of restricting nitrofen use on California cauliflower, by county

County	Treated acres	Total cost of weed control programs			Changes in treatment costs			
		Programs with nitrofen	Programs without nitrofen, with CDEC	Programs without nitrofen or CDEC	Without nitrofen, with CDEC		Without nitrofen or CDEC	
					Per acre	Total	Per acre	Total
			($1,000)		$	($1,000)	$	($1,000)
Monterey a/	7,650	1,304	1,786	1,834	63	482	69	530
Santa Barbara b/	4,320	697	1,064	1,132	85	367	101	435
Orange, Ventura, San Diego, Santa Cruz c/	3,744	583	766	769	49	183	50	186
Total	15,714	2,584	3,616	3,735	66	1,032	73	1,151

a/ Appendix Table 2.
b/ Appendix Table 3.
c/ Appendix Table 4.

Preliminary Benefit Analysis of Preemergent Nitrofen Use on California Celery

Current Use Analysis

EPA Registrations of Nitrofen and Alternatives

Nitrofen, formulated as an emulsifiable concentrate (25 percent active ingredient) is currently registered for preemergent use on celery to control a variety of weeds including: annual bluegrass, crabgrass, goosefoot, lambsquarters, malva, nightshade, nettle, pigweed, purslane, shepherdspurse, and spergularia (USDA/EPA/States, 1980).

Rohm and Haas is currently proposing to amend the TOK E-25® (nitrofen 25 EC) registration and resume marketing in California under the provisions of an amended label and a restrictive contract with its distributor/applicator customers. Under the amended label, nitrofen 25 EC would be registered for preemergent use on direct seeded celery in California. The label would call for a single preemergent spray (after seeding), at the rate of 1 1/2 to 3 gallons (3 to 6 pounds a.i. per acre) (USDA/EPA/States, 1980).

The major alternative herbicides registered for weed control on California celery are prometryne, chloroxuron, and trifluralin (USDA/EPA/States, 1980).

SUMMARY OF PRELIMINARY BENEFIT ANALYSIS OF PREEMERGENT NITROFEN USE ON CALIFORNIA CELERY

USE: Nitrofen use on California celery.

MAJOR PESTS CONTROLLED:

annual bluegrass	lambsquarters	nettle	shepherdspurse
crabgrass	malva	pigweed	spergularia
goosefoot	nightshade	purslane	

ALTERNATIVES:

Major registered chemicals: prometryne, chloroxuron, and trifluralin

Comparative efficacy/performance: Use of alternative weed control methods would maintain current yields and quality in the short run. In the longer run, yields may decline due to anticipated buildup of weed populations.

Comparative costs:

County	Nitrofen Program Cost/Acre ($)	Alternative Program Cost/Acre ($)	Difference in Cost/Acre ($)
Santa Barbara	172-190	191-209	19
Monterey	172-190	187-213	15-23

EXTENT OF USE:

Acres Treated	% of California Acreage (1980)	% of U.S. Celery Acreage (1980)	Quantity of Nitrofen Used Annually (lb. a.i.)
2,569	12	7	5,138

ECONOMIC IMPACTS:

User: The cancellation of nitrofen and the substitution of alternative herbicides for weed control on direct seeded celery would result in higher treatment costs for growers. The use of alternative herbicides would increase annual production costs by about $19 per acre in Santa Barbara County and $15 to $23 per acre in Monterey County. In the short run, the total increase of production costs on the affected acreage in California (2,569 acres) would range from about $47 to $53 thousand per year, an increase of less than 1 percent in annual production costs. For the average size grower with 136 to 146 acres of celery, the use of alternative weed controls would increase annual production costs by about $2,400 to $3,100.

In the long run the weed population may increase and eventually affect yields and quality of celery output.

Market/Consumer: The use of alternative herbicides in place of nitrofen would have little or no impact on the industry supply or quality of output. Since the affected celery acreage represents only 7 percent of total U.S. celery output, the increased production costs would be expected to have no significant impact on retail prices in the short run. In the long run, the increasing weed population in the impacted areas could eventually reduce celery output and/or quality and cause upward pressure on retail prices.

Macroeconomic: No significant macroeconomic impact expected.

SOCIAL/COMMUNITY IMPACTS: Alternative weed control programs may require additional field labor. The increased demand for field labor may bid up wages and in some cases cause shortages of field labor.

The use of alternative weed control programs and the reallocation of land to other crops may lead to an increased demand for new farm equipment and other factors of production.

LIMITATIONS OF ANALYSIS: Estimates of comparative efficacy of nitrofen and alternative herbicides were based on the experience of weed science specialists and not on field data.

There are insufficient biological and economic data to assess potential long run impacts of increasing weed pressure following a nitrofen suspension.

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Extent of Nitrofen Use

Of approximately 3,950 acres of direct seeded celery grown in California during 1980, an estimated 2,569 acres (12 percent of the total California acreage and 7 percent of the total U.S. acreage) are expected to be treated with nitrofen 25 EC if it is available for use. The typical method of applying nitrofen to the celery acreage would be by means of band sprays, at the rate of 2 pounds active ingredient per acre (Nitrofen Assessment Team, 1981). (The suggested label rate for broadcast sprays is 3 to 6 pounds active ingredient per acre.) Assuming that nitrofen is applied by means of band sprays, the total amount of nitrofen applied to California celery each year would be about 5,138 pounds active ingredient (Nitrofen Assessment Team, 1981).

Nearly all of the treated acreage would be located in Monterey and Santa Barbara Counties where the average acreage for celery farms are 136 and 146 acres respectively (U.S. Department of Commerce, 1977).

Farm Impacts

Production Cost Changes

The typical nitrofen weed control programs for California celery would include a preemergent band application of nitrofen and prometryne as well as a postemergent application of either prometryne or chloroxuron mixed with oil. In addition to herbicide treatments, these programs would be expected to include four mechanical cultivations, one thinning/hoeing operation, and one weed hoeing operation per season.

The per acre costs of the nitrofen programs are estimated to be about $172 to $190 (Table 1). Since an estimated 1,125 and 1,144 acres of celery would be treated with nitrofen in the counties of Santa Barbara and Monterey respectively, the total cost of the nitrofen programs would range from about $442 to $488 thousand per season (Table 2).

If nitrofen use on direct seeded celery were denied, growers would likely substitute alternative herbicides and/or additional field operations. In Santa Barbara County, the affected growers would be expected to use prometryne at preemergence as well as prometryne or chloroxuron mixed with oil at postemergence on all of the 1,125 impacted acres. Since the use of these herbicides without nitrofen would be expected to provide less effective weed control, it was estimated that the time required for thinning/hoeing would increase by about 3.5 hours per acre (Nitrofen Assessment Team, 1981). The total costs for the alternative weed control programs in Santa Barbara County were estimated to be about $191 to $209 per acre (Table 3), an increase of about $19 per acre over the cost of the nitrofen program.

In Monterey County, the alternative weed control programs would include the use of prometryne and/or chloroxuron along with increased field labor for thinning and weed hoeing operations (Table 4). The costs of these programs would range from about $187 to $213 per acre, an increase of about $15 to $23 per acre over the cost of the nitrofen programs.

The total cost of the alternative weed control programs in Monterey and Santa Barbara counties would be about $495 to $535 thousand per season (Table 5), an increase of about $47 to $53 thousand over the estimated cost of the nitrofen programs. The overall cost increase per impacted acre would average about $18 to $21 per season. For the average size grower with 136 to 146 acres of celery, the use of alternative weed controls would increase annual production costs by about $2400 to $3100.

Based on the 1981 preliminary budget estimates for growing direct seeded celery in Santa Barbara (University of California, 1981), this average increase in weed control costs resulting from the use of alternative pesticides would represent an increase of less than one percent in overall production costs. In the short run, the use of alternative herbicides and increased cultural weed control efforts would be expected to result in little or no adverse impacts on celery yields or quality if nitrofen is unavailable (Nitrofen Assessment Team, 1981).

Although a denial of nitrofen use is expected to have no significant impact on yields or quality of ouput in the short run, the use of less effective alternative herbicides may result in a gradual increase of weed pressure in certain areas. Specific weeds, such as malva, shepherdspurse and spergularia, which are not effectively controlled by alternative herbicides may become especially troublesome for celery growers in the long run. Increasing weed pressure may eventually have significant impacts on yields and/or quality of celery

output. In some severely impacted areas, growers may switch from direct seeded to transplanted celery. Others may eventually decide to reallocate their celery acreage to other agricultural uses less affected by the growing weed population. The lack of biological data prevents a quantitative estimate of these potential long run impacts.

Consumer Impacts

In the short run, consumers of celery would not be significantly affected by the denial of nitrofen use. Alternative weed controls would maintain current crop yield and quality levels. Since the impacted acreage represents only about 12 percent of California's total celery acreage (7 percent of the U.S. celery acreage), it is likely that impacted growers would absorb most or all of their production cost increases rather than pass them on to consumers in the form of higher prices.

In the long run, the increasing weed population in the impacted areas could eventually reduce celery output and/or quality and cause some upward pressure on retail prices. Current biological information is insufficient to estimate the extent of these potential long run impacts on celery consumers.

Social/Community Impact

The additional hoeing operations required by alternative weed control programs would increase the seasonal demand for field labor and

and possibly bid up current wages. In some areas there could be seasonal shortages of field labor.

The use of alternative weed control programs or the reallocation of land to other crops could lead to an increased demand for new farm equipment and other factors of production.

Limitations of Analysis

1. There are insufficient biological and economic data for long run estimates of potential crop shifts following a nitrofen suspension.

2. This analysis assumes that adequate supplies of labor for additional hoeing operations and mechanical cultivations are available for the alternative weed control programs used on celery.

3. The price of field labor is assumed to remain constant in the short run, at $7.50 per hour.

4. The future availability of chloroxuron is uncertain since domestic producers have recently terminated production. At present, there appears to be sufficient stocks of chloroxuron on hand for at least one more year of use.

5. The suspension of nitrofen is expected to have a cumulative impact on future celery crops over the next couple of years as potential increases in weed populations may affect output. Current data limitations prevent a quantitative assessment of the long run impacts.

Table 1. Per Acre Costs of Preemergent Nitrofen Weed Control Programs for Direct Seeded Celery in Santa Barbara and Monterey Counties of California

d Control rogram	Application Rate (Lbs. A.I.)	Cost Per Lb. of A.I. 1/ ($)	Herbicide + Applicaton Cost Per Acre 2/ ($)	Cultivation Cost Per Acre 3/ ($)	Thin Hoeing Cost Per Acre 4/ ($)	Weed Hoeing Cost Per Acre 5/ ($)	Total Costs Per Acre ($)
E. nitrofen + prometryne	2 + 1	7.42 + 7.95	30.79				
t E. prometryne	1	7.95	15.95				
			46.74	28.00	52.50	45.00	172.24
E. nitrofen + prometryne	2 + 1	7.42 + 7.95	30.79				
t E. chloroxuron + rop oil	1 + 1 (gal.)	7.00 + 18.70/gal.	33.70				
			64.49	28.00	52.50	45.00	189.99

The latest nitrofen prices available were for 1980, prior to the voluntary removal of nitrofen from the market by Rohm and Haas. Prices for the alternative pesticides are for 1981.
Includes herbicide cost plus an application cost of $8.00 per acre.
4 cultivations per season at $7.00 per acre per time.
Hand hoeing operation used to thin out crop plants, 7 hours of field labor per acre at $7.50 per hour.
Hand hoeing operation used to reduce weeds, 6 hours of field labor per acre at $7.50 per hour.

urces: Nitrofen Assessment Team, 1981.
Galt et al., 1981.

Table 2. Total Cost of Preemergent Nitrofen Weed Control Programs for Direct Seeded Celery in Santa Barbara and Monterey Counties of California

County	Weed Control Program	Cost Per Acre 1/ ($)	Number of Acres Treated	Total Cost ($)
Santa Barbara	nitrofen (pre) + prometryne (pre) + prometryne or chloroxuron + crop oil (post)	172.24 - 189.99	1,125	193,770 - 213,739
Monterey	nitrofen (pre) + prometryne (pre) + prometryne or chloroxuron + crop oil (post)	172.24 - 189.99	1,444	248,715 - 274,346
			2,569	442,485 - 488,085

1/ See Table 1.

Sources: Nitrofen Assessment Team, 1981.
Galt et al., 1981.

Table 3. Per Acre Costs of Alternative Weed Control Programs for Direct Seeded Celery in Santa Barbara County of California

Weed Control Program	Application Rate (Lbs. A.I.)	Cost Per Lb. of A.I. ($)	Herbicide + Applicaton Cost Per Acre 1/ ($)	Cultivation Cost Per Acre 2/ ($)	Thin Hoeing Cost Per Acre 3/ ($)	Weed Hoeing Cost Per Acre 4/ ($)	Total Costs Per Acre ($)
Pre E. prometryne	1	7.95	15.95				
Post E. prometryne	1	7.95	15.95				
			31.90	28.00	78.75	52.50	191.15
Pre E. prometryne	1	7.95	15.95				
Pre E. chloroxuron + crop oil	1 + 1 (gal.)	7.00 + 18.70/gal.	33.70				
			49.65	28.00	78.75	52.50	208.90

1/ Includes herbicide cost plus an application cost of $8.00 per acre.
2/ 4 cultivations per season at $7.00 per acre per time.
3/ Hand hoeing operation used to thin out plants, 10.5 hours of field labor per acre at $7.50 per hour.
4/ Hand hoeing operation used to reduce weeds, 7 hours of field labor per acre at $7.50 per hour.

Sources: Nitrofen Assessment Team, 1981.
Galt et al., 1981.

Table 4. Per Acre Costs of Alternative Weed Control Programs for Direct Seeded Celery in Monterey County of California

Weed Control Program	Application Rate (Lbs. A.I.)	Cost Per Lb. of A.I. ($)	Herbicide + Applicaton Cost Per Acre 1/ ($)	Cultivation Cost Per Acre 2/ ($)	Thin Hoeing Cost Per Acre 3/ ($)	Weed Hoeing Cost Per Acre 4/ ($)	Total Costs Per Acre ($)
Pre E. prometryne + chloroxuron	1 + 1	7.95 + 7.00	22.95				
Post E. chloroxuron + crop oil	1 + 1 (gal.)	7.00 + 18.70/gal.	33.70				
			56.65	28.00	67.50 5/	52.50	204.65
Pre E. prometryne + chloroxuron	1 + 1	7.95 + 7.00	22.95				
Post E. prometryne	1	7.95	15.95				
			38.90	28.00	67.50 5/	52.50	186.90
Pre E. prometryne	1	7.95	15.95				
Post E. chloroxuron + crop oil	1 + 1 (gal.)	7.00 + 18.70/gal.	33.70				
			49.65	28.00	78.75 6/	52.50	208.90
Pre E. prometryne	1	7.95	15.95				
Post E. prometryne	1	7.95	15.95				
			31.90	28.00	78.75 6/	52.50	191.15
Pre E. prometryne	1	7.95	15.95	28.00	78.75 6/	90.00 7/	212.70

1/ Includes herbicide cost plus an application cost of $8.00 per acre.
2/ 4 cultivations per season at $7.00 per acre per time.
3/ Hand hoeing operation used to thin out crop plants. Except where noted, the operation requires 9 hours of field labor per acre at $7.50 per hour.
4/ Hand hoeing operation used to reduce weeds. Except where noted, the operation requires 7 hours of field labor per acre at $7.50 per hour.
5/ 9 hours of field labor at $7.50 per hour.
6/ 10.5 hours of field labor at $7.50 per hour.
7/ 12 hours of field labor at $7.50 per hour.

Sources: See Table 1.

Table 5. Total Cost of Alternative Weed Control Programs for Direct Seeded Celery in Santa Barbara and Monterey Counties of California

County	Weed Control Program 1/	Cost Per Acre 1/ ($)	Number of Acres Treated	Total Cost ($)
Santa Barbara	prometryne (pre) prometryne or chloroxuron + crop oil (post)	191.15 - 208.90	1,125	215,044 - 235,013
Monterey	prometryne (pre) + chloroxuron (pre) prometryne or chloroxuron + crop oil (post)	186.90 - 204.65	722	134,942 - 147,757
	prometryne (pre) prometryne or chloroxuron + crop oil (post)	191.15 - 208.90	401	76,651 - 83,769
	prometryne (pre)	212.70	321	68,277
	Total		2,569	494,914 - 534,816

1/ See Tables 3 and 4.

Sources: Nitrofen Assessment Team, 1981.
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